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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/723,117	11/26/2003	Gang Gu	006161.P001	1307
7590	01/06/2005		EXAMINER	
Steve De Klerk BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP Seventh Floor 12400 Wilshire Boulevard Los Angeles, CA 90025			OLSEN, KAJ K	
			ART UNIT	PAPER NUMBER
			1753	
DATE MAILED: 01/06/2005				

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/723,117

Applicant(s)

GU ET AL.

Examiner

Kaj K Olsen

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 26 October 2004.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 7 and 41-64 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 7, 41-46 and 48-64 is/are rejected.
- 7) ☒ Claim(s) 47 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Claim Rejections - 35 USC § 112

1. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

2. Claims 58-64 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. New claims 58-64 are drawn to a method for sensing a specific molecule that comprises the step of measuring a change in a work function of one of the two electrodes. However, the specification does not appear to support this limitation. In particular, the specification teaches monitoring the resistance (or conductance) of the nanoelements across the electrodes and mentions that that resistance is a function of the changing work function (see paragraph 0032). However, applicant does not appear to ever relate back this resistance back to a changing work function. Hence applicant does not ever teach a step of “measuring a change in work function of one of the electrodes” per se. The changing work function might be in part the phenomenological basis for the change in resistance or conductance (although many other factors could contribute to the measured resistance or conductance (see Cui or Dai relied on below for example)), absent any explicit step of measuring a work function or relating the measured resistance back to a work function, this new limitation is not enabled by the originally filed disclosure.

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3. Similarly, applicant also claims measuring the Schottky barrier. Although the applicant discussed altering the Schottky barrier (see paragraph 0041), applicant does not appear to have ever explicitly disclosed measuring a Schottky barrier per se.

4. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

5. Claims 7 and 41-45 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

6. Amended claim 7 is indefinite because it refers to a nanoelement earlier in the claim and later states that the element is a nanotube. In view of claims 42-45, it would appear that the “nanotube” of claim 7 should be --nanoelement--.

Claim Rejections - 35 USC § 102

7. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

8. Claims 46, 48, 50, 53, 54, 56 and 57 are rejected under 35 U.S.C. 102(e) as being anticipated by Dai et al (USP 6,528,020) with evidence by Dijksma et al (Anal. Chem. 2001, 73,

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pp. 901-907). Both references are being cited and relied on for the first time with this office action. Their use here was necessitated by these new claims.

9. With respect to claim 46, Dai discloses a substrate 22, a nanotube 20 having first and second ends disposed on the substrate and a pair of electrodes 23 disposed on the substrate with each electrode contacting an end of the nanotube. With respect to the electrode comprising a surface layer having the broadly defined “affinity for the bio-molecule”, Dai teaches the use of a gold layer for the electrode (col. 2, lines 52 and 53) and Dijksma teaches that gold layers have an affinity for sulfur containing biomolecules such as cysteine (see abstract). Hence the surface layer of Dai would meet the broadly defined requirement of having affinity for a bio-molecule. With respect to the sensor being for the sensor of a bio-molecule, that is only the intended use of the apparatus and the intended use need not be given further due consideration in determining patentability.

10. With respect to the bio-molecule being streptavidin, that is only the intended use of the apparatus and the intended use need not be given further due consideration in determining patentability.

11. With respect to claims 50, 53, 54, 56 and 57 (those limitations not covered above), Dai also teaches the use of a coating of polymethylmethacrylate (PMMA) over the nanotube. See col. 5, lines 44-50. Such a coating would read on the broadly defined “protective layer” over the nanoelement.

12. With respect to the interconnected nanotubes, see col. 2, lines 38-47 and col. 4, lines 5-11.

Claim Rejections - 35 USC § 103

13. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

14. Claims 7, 41-43 and 45 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cui et al (Science, 293, August 2001, pp. 1289-1292) in view of Krstic et al (Electronic Properties of Novel Materials-Molecular Nanostructures, 2000, pp. 367-370) with evidence provided by Heo et al (Applied Physics Letters, 81 (16), 2002, PP. 3046-3048). Heo is being cited and relied on for evidence for the first time with this office action. Its use here was necessitated by new claim 45 drawn to a “nanorod”.

15. Cui discloses a substrate with a nanoelement (a nanowire) and two electrodes disposed on the substrate with each electrode contacting an end of the nanoelement. See fig. 1. Cui did not particularly set forth the use of electrode materials such as palladium. Krstic teaches in an alternate nanoelement device that metals such as gold and palladium alloys find utility as electrodes for these nanoelements (see experimental section). These metals have been shown to minimize the contact resistance between the nanoelement and the electrode (see introduction section). It would have been obvious to one of ordinary skill in the art at the time the invention was being made to utilize the teaching of Krstic for the device and method of Cui because the substitution of one known electrode material for another requires only routine skill in the art. In addition, the particular use of Pd alloys have been shown to provide low contact resistance thereby improving the sensor responsiveness. With respect to the palladium of Krstic constituting a “surface layer including Pd”, any electrode constructed of Pd would inherently have a surface layer comprising Pd.

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16. With respect to the use of nanotubes, see both Cui, second paragraph of p. 1289 and Krstic in its entirety.

17. With respect to the use of a gate electrode, see paragraph bridging pp. 1289 and 1290 and fig. 1A of Cui.

18. With respect to the claimed “nanorod”, applicant never defines how this element would read away from the more typical terms “nanowire” and “nanotube”. Heo evidences that the term “nanorod” reads on materials that are dimensionally analogous to the nanowires and nanotubes of Cui (compare Heo abstract with Cui, reference number 15). Hence the claimed nanorods either read on the nanowires and nanotubes of Cui and Krstic or are an obvious equivalent thereof.

19. Claims 7, 43 and 44 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dai in view of Krstic.

20. Dai set forth all the limitations of the sensor of claim 7 (see rejection above for details), but Dai did not explicitly disclose the presence of a surface layer including Pd. However, as discussed above and in the previous office action, Krstic teaches that alloys of palladium also provide equivalent behavior to that of gold as an electrode. See pp. 368 and 369. It would have been obvious to one of ordinary skill in the art at the time the invention was being made to utilize the teaching of Krstic for the sensor of Dai because the substitution of one known electrode material for another known electrode material requires only routine skill in the art. With respect to the palladium of Krstic constituting a “surface layer including Pd”, any electrode constructed of Pd would inherently have a surface layer comprising Pd.

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21. Claims 41, 42 and 45 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dai and Krstic as applied to claim 7 above, and further in view of Cui with evidence by Heo.

22. Claims 51, 52 and 55 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dai in view of Cui with evidence by Heo.

23. With respect to claims 41 and 55, Dai or Dai in view of Krstic set forth all the limitations of the claim, but did not teach the use of a gate electrode disposed between the two electrodes and beneath the nanoelement. As discussed above, Cui shows that the presence of a gate electrode in that set forth position allows one greater control of the sensor behavior. See fig. 1B and p. 1290. With respect to claims 42, 45, 51 and 52, Cui also teaches the equivalence of materials such as silicon nanowires for the sensing device (see fig. 1A). It would have been obvious to one of ordinary skill in the art at the time the invention was being made to utilize the teaching of Cui for the sensor of Dai or Dai in view of Krstic both because a gate electrode allows one greater control of the sensor properties for the sensor and because the substitution of one known nanoelement for another known nanoelement requires only routine skill in the art.

24. With respect to the “inorganic nanorod” of claims 45 and 52, applicant never defines how this element would read away from the more typical terms “nanowire” and “nanotube”. Heo evidences that the term “nanorod” reads on materials that are dimensionally analogous to the nanowires and nanotubes of Cui and Dai (compare Heo abstract with Cui, reference number 15). Hence the claimed nanorods either read on the nanowires and nanotubes of Cui and Dai or are an obvious equivalent thereof.

25. Claim 44 is rejected under 35 U.S.C. 103(a) as being unpatentable over Cui and Krstic as applied to claim 43 above, and further in view of Dai.

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26. Cui and Krstic set forth all the limitations of the claim, but did not explicitly recite the presence of a network or interconnected nanotubes. Dai teaches that a plurality of nanotubes that are interconnected can also be utilized for establishing the electrical connection. The plurality of tubes has the advantage of being easier to construct than single nanoelement embodiments and also provides greater electrical pathways. See col. 2, lines 38-47 and col. 4, lines 5-11. It would have been obvious to one of ordinary skill in the art at the time the invention was being made to utilize the teaching of Dai for the sensor of Cui and Krstic in order to simplify sensor construction and to increase the electrical pathways between the electrodes.

27. Claims 46, 48 and 49 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cui in view of Krstic with evidence by Dijksma et al (Anal. Chem. 2001, 73, 901-907).

28. Cui and Krstic set forth all the limitations of the claims (see previous rejection above). In addition, Krstic taught that an electrode constructed of gold would also have been an obvious choice of electrode material. See the abstract and section titled "Gold (Au)" on pp. 368 and 369. With respect to the broadly claimed surface layer having an affinity for a bio-molecule, gold is known to have an affinity for sulfur containing biomolecules such as cysteine (see abstract of Dijksma). Hence an electrode having gold at the surface would meet the claim limitation. Krstic also teaches combinations of gold and palladium. Although Krstic does not suggest a layer of gold over the palladium, one possessing ordinary skill in the art would recognize utilizing said combination of known metals in those patterns would have required only routine skill in the art.

29. With respect to the bio-molecule being streptavidin, that is only the intended use of the apparatus and the intended use need not be given further due consideration in determining patentability.

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30. Claims 50-57 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cui in view of Dai.

31. With respect to the claims, Cui set forth all the limitations of the claims (see rejections above), but did not explicitly disclose the presence of a protective layer over the nanoelement. As discussed above, such a protective layer is taught by Dai as improving the sensitivity of the sensor for particular constituents. See col. 5, lines 44-50. It would have been obvious to one of ordinary skill in the art at the time the invention was being made to utilize the teaching of Dai for the sensor of Cui in order to improve the sensitivity and selectivity of the sensor.

32. Claims 58-64 are rejected under 35 U.S.C. 102(b) or (e) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over either Cui or Dai with or without the further teaching of Krstic.

33. With respect to these method claims, it is unclear how to interpret them when they are based on a step (i.e. measuring a change in work function of one of the electrodes) that has never been explicitly disclosed by the instant invention (see 112 rejection above). Because both Cui and Dai set forth all the structural elements of the sensor (see rejection above), and because both Cui and Dai are drawn to a sensor where the change in conductance of the sensor is utilized to determine the presence of a specific analyte (like the instant invention), these claims are deemed to be anticipated by or obvious over Cui and Dai. Alternatively, if these method claims are instead interpreted as requiring the presence of an electrode that would be subject to a change in work function upon exposure to a specific analyte, Krstic already rendered obvious the use of an electrode material that the instant invention evidences is subject to a work function change upon exposure to specific gas molecules (i.e. a AuPd alloy). Because it would have been obvious to

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utilize said alloy as an electrode material for Cui and Dai (see the previous motivation above), these claims would then also be obvious over either Cui or Dai in further view of Krstic.

Allowable Subject Matter

34. Claim 47 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

35. The prior art does not disclose nor render obvious all the limitations of claim 46 and further comprising that the surface layer of the electrode comprise biotin.

Response to Arguments

36. Applicant's arguments filed 10-26-2004 have been fully considered but they are not persuasive. With respect to claim 7, applicant urges that neither Cui nor Krstic teach nor suggest the presence of a Pd surface layer on the electrodes. Although the examiner agrees with that conclusion as it pertains to Cui, the examiner does agree with that conclusion as it pertains to Krstic. In particular Krstic teaches the use of electrodes constructed of palladium (see previous rejection as well as the modified rejection above). Because Krstic teaches the presence of an electrode containing Pd, Krstic thereby teaches an electrode "including a surface layer including Pd". There is nothing inherent in this new claim language that requires the Pd to be some unique layer on top of the remaining electrode material (i.e. the palladium need not be a coating). In addition, even if the examiner were to interpret claim 7 as requiring a unique coating of palladium distinct from the remainder of the electrode, the examiner already urged that one

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possessing ordinary skill in the art would have been motivated to provide the palladium as such a coating (see paragraph 17 of the previous office action). The applicant has never argued why the examiner was in error with his previous conclusion concerning the use of coatings of electrode material.

37. The remaining arguments concern the new claims and these arguments are moot in view of the new grounds of rejection.

Conclusion

38. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a).

Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Kaj Olsen whose telephone number is (571) 272-1344. The

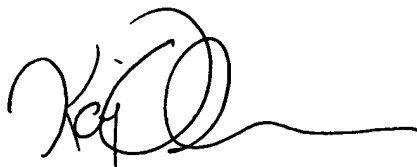
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examiner can normally be reached on Monday through Thursday from 5:30 A.M. to 3:00 P.M. and on alternate Fridays.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen, can be reached on 571-272-1342. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

AU 1753
January 4, 2005



KAJ K. OLSEN
PRIMARY EXAMINER